

Exploration Permits 112, 125, 82, and 105 – Exploration
Program

Environment Plan

Santos

Facility: Southern Amadeus Basin Exploration
Project Title: 2016 Southern Amadeus 2D Seismic Program



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1 CORPORATE ENVIRONMENTAL POLICY

1.1 *Environmental Policy and Commitment*

The Santos Corporate Environmental Policy is provided in Figure 1-1. The policy is Santos' public declaration to reducing the environmental impacts and risks associated with its operations.

1.2 *Environmental Performance Objectives*

Santos has defined ten (10) performance objectives for the works included in the 2016 Southern Amadeus Seismic Program ('the Program') Environment Plan (EP). The performance objectives are to:

1. Minimise the visual impact of seismic operations;
2. Minimise disturbance to and contamination of soil resources;
3. Minimise disturbance to native vegetation and native fauna;
4. Avoid disturbance to sites of cultural, sacred and heritage significance;
5. Minimise disturbance to livestock, pastoral infrastructure and landholders;
6. Avoid the introduction or spread of exotic species and implement control measures as necessary;
7. Minimise disturbance to drainage patterns and avoid contamination of surface waters and shallow groundwater resources;
8. Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal;
9. Remediate and rehabilitate operational areas as necessary; and
10. Generate no fires from the Seismic operations.

1.3 *Responsibility for Corporate Environmental Policy*

The Santos Environmental Policy was approved (and signed) by the Chief Executive Officer and Managing Director. All personnel are responsible for the environmental performance of their activities and for complying with the general environmental duty as outlined in the Santos Environmental Policy.

The Manager, Geophysical Services, is responsible for the implementation of the EP for the Program. Their responsibilities include:

- Ensuring conformance with the Santos Environment, Health and Safety Management System (EHSMS);
- Ensuring required permits and approvals are in place and complied with;
- Management of non-compliances and non-conformances;
- Inductions of staff and contractors;
- Satisfying monitoring and reporting requirements;
- Incident management and reporting;
- As and where required, conducting internal and external audits; and
- Records management including waste records and hazardous goods manifests.

The Seismic Contractors are responsible for ensuring compliance with the EP through contractual commitments.



1.4 *Approval of this Plan*

This plan was approved by:

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Environmental Policy

Our Environmental Vision:

"We will minimise our environmental impact across the whole lifecycle of our activities."

At Santos we adopt the principles of sustainable development. We recognise our responsibility to meet community expectations and we are committed to the continuous improvement of our environmental performance. We believe that environmental stewardship is both a management obligation and the responsibility of every individual. To achieve this we will:

- Comply with and continuously improve the Environment, Health and Safety Management System (EHSMS) across the business.
- Proactively identify environmental hazards, assess their risk and eliminate or, if not possible, manage the risk to as low as reasonably practicable.
- Establish annual environmental objectives and targets, implement programs to achieve them, and review and report on environmental performance against those objectives and targets.
- As a minimum comply with relevant legal and other requirements.
- Ensure that we have the resources and skills necessary to achieve our environmental commitments.
- Include environmental performance in the appraisal of workers' performance.
- Implement strategies to minimise pollution, manage waste, use water and energy efficiently, and address relevant biodiversity issues.
- Formally monitor, audit, review and report annually on our environmental performance and EHSMS requirements against defined objectives.
- Require that companies providing contract services to Santos manage their environmental performance in line with this Policy.
- Positively influence the environmental performance of Joint Venture activities operated by others.



Kevin Gallagher
Managing Director and Chief Executive Officer

Santos Limited	ABN 80 007 550 923
Policy reference number	P040
Title	Santos Environmental Policy
Date approved	8 February 2016
Approved by	
Responsibility for review	
Frequency of review	3 years

Figure 1-1: Santos Environmental Policy

2 ENVIRONMENTAL LEGISLATION AND OTHER REQUIREMENTS

The *Petroleum Act 2011* is the principal piece of legislation governing the Program. In addition, the Act is supported by the *Petroleum Regulations* (Regulations) and the *Schedule of Onshore Petroleum Exploration and Production Requirements, 2012* (Requirements).

In accordance with Section 67 of the *Petroleum Act*, exploration activities such as the seismic surveys require approval to be obtained from the Northern Territory (NT) Department of Mines and Energy (DME) by the tenure holder prior to commencing works.

Formal Program approval is required from the NT Director of Energy in accordance with clause 501 of the *NT Schedule of Onshore Petroleum Exploration and Production Requirements, 2012*.

Santos is in regular contact with the DME to ensure changes in environmental legislation are met as required.

A list of relevant legislation, agreements and codes of practice relevant for the Program is provided in Sections 2.1 to 2.3.

2.1 Key Legislation Overview

Act	Summary
Commonwealth	
<i>Aboriginal Land Rights (Northern Territory) Act 1976</i>	Provides for the preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition.
<i>Australian Heritage Council Act 2003</i>	Establishes the Australian Heritage Council that is the principal adviser to the Australian Government on heritage matters. The Council's major role is to assess the heritage values of places nominated for the National Heritage List and the Commonwealth Heritage List, and to advise the Minister on promotion, research, education, policies, grants, conservation and other matters.
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	Provides for the protection of the environment and the conservation of biodiversity. It regulates a development or activity if it is likely to have a significant environmental impact on 'matters of national environmental significance' (MNES). This Act is administered by the Department of the Environment (DoE). It is considered that the proposed activities will not adversely impact MNES, and has not been referred for assessment and approval under the EPBC Act.
<i>National Environment Protection Council Act 1994</i>	Provides national standards for ambient air quality, movement of controlled wastes, and contaminated sites. This Act is administered by DoE.
<i>Native Title Act 1993</i>	This Act provides statutory recognition and protection for the concept of native title, including provisions for reaching Indigenous land use agreements.
Northern Territory	

Act	Summary
<i>Aboriginal Land Act 2013</i>	Provides access to areas which are Aboriginal land, whether it is on land or sea.
<i>Biological Control Act 2011</i>	Makes provision for the biological control of pests in the NT, and related purposes.
<i>Bushfires Act 2014</i>	Provides for the prevention and suppression of bushfires in the NT.
<i>Control of Roads Act 2015</i>	Provides for the administration and control of roads, including the maintenance of roads and opening and closing of roads.
<i>Dangerous Goods (Road and Rail Transport) Act 2012</i>	Makes provision for safety in the transport of dangerous goods by road as part of the system of nationally consistent road transport laws and makes provision for safety in the transport of dangerous goods by rail. Establishes common guidelines so that dangerous goods can be transported between states and territories.
<i>Environmental Assessment Act 2013</i>	<p>Establishes the framework for the assessment of potential or anticipated environmental impacts of development, and provides for protection of the environment. The NT Environmental Protection Authority (EPA) is responsible for administering the act.</p> <p>The EPA also determines the appropriate level of assessment for new developments or material changes to existing operations, based on the sensitivity of the local environment, the scale of the proposal and its potential impact upon the environment.</p> <p>Note: This Program is not subject to this Act and will be approved under the <i>Petroleum (Prospecting and Mining) Act 1980</i>.</p>
<i>Environmental Offences and Penalties Act 2011</i>	Establishes a penalty structure for environmental offences based around four offence levels. Penalties are defined in a variety of environmental statutes such as the <i>Waste Management and Pollution Control Act</i> and the <i>Water Act</i> .
<i>Fire and Emergency Act 2015</i>	Provides for the establishment of the Northern Territory Fire and Rescue Service, the operational and emergency response activities of the Service, the protection of life, property and the environment against fires and other emergencies and for related purposes.
<i>Heritage Act 2015</i>	Establishes the Heritage Council and the NT Heritage Register. It sets the process by which places become heritage places, allows for interim protection of places and sets out the process for getting permission to do work to heritage places and allows for fines and imprisonment for offences against the Act.
<i>Northern Territory Aboriginal Sacred Sites Act 2013</i>	Establishes the Aboriginal Areas Protection Authority (AAPA) as the body responsible for overseeing the protection of sacred sites in the Northern Territory. The AAPA provides a process for avoidance of sacred sites and entry onto sacred sites and the issue of Authority Certificates which indemnify the holder against prosecution under the Act for damage to sacred sites in the certificate area, provided works

Act	Summary
	or use has occurred in accordance with the conditions of the Authority Certificate.
<i>Plant Health Act 2015</i>	Provides the framework to ensure appropriate actions can be taken for the control of pests; and facilitates the production and trading of plants and plant products that are free from pests.
<i>Petroleum Act 2016</i>	<p>Provides a legal framework to undertake exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the NT.</p> <p>The <i>Petroleum Act</i> is the principal legislation dealing with petroleum tenure, exploration and production activities onshore and inland waters of the Territory.</p> <p>Most current petroleum permits and licences are governed by the <i>Petroleum Act</i> (Act). In addition, the Act is supported by the <i>Petroleum Regulations</i> (Regulations) and the <i>Schedule of Onshore Petroleum Exploration and Production Requirements 2012</i> (Requirements).</p> <p>The Act, Regulations and Requirements are administered by the Northern Territory Petroleum Registry (Registry) which forms part of the DME. The Minister for Mines and Energy (Minister) is the applicable Minister for the purposes of the Act.</p>
<i>Public and Environmental Health Act 2015</i> and <i>Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations</i>	<p>Makes provision to protect and promote the health of individuals and communities in the Territory, and to monitor, assess and control environmental conditions, factors and agents, facilities and equipment and activities, services and products that impact on or may impact on public and environmental health.</p> <p>Relates to public health and is directed at preventing pollution of water-courses and water supplies in the Northern Territory. Wastewater treatment systems may be subject to requirements under the <i>Public Health Act 1987</i> and Regulations. Sewerage Plants need to meet the NT Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent.</p>
<i>Schedule of Onshore Petroleum Exploration and Production Requirements 2012 (under the Petroleum Act 2016)</i>	Sets out detailed requirements, including approval for seismic activities and reporting of incidents.
<i>Soil Conservation and Land Utilisation Act 2013</i>	Makes provisions for the prevention of soil erosion and soil conservation and reclamation. It makes provisions for restricting construction activities that may damage or further damage land that is not environmentally stable, such as areas suffering soil erosion or areas that have the potential to erode.
<i>Territory Parks and Wildlife Conservation Act 2011</i>	Makes provision for the establishment of Territory Parks and other Parks and Reserves and the study, protection, conservation and sustainable utilisation of wildlife. It sets aside areas of the NT as parks and conservation areas that may not be developed.

Act	Summary
<i>Waste Management and Pollution Control Act 2014</i>	Aims to protect, and where practicable, restore and enhance the quality of the NT environment; encourage ecologically sustainable development; and facilitate the implementation of NEPMs established by the National Environment Protection Council. It is designed to prevent contamination of the surrounding environment, including soil, air, and water, and imposes a general duty on conducting an activity or action that causes or is likely to cause pollution resulting in environmental harm, or that generates or is likely to generate waste.
<i>Water Act 2013</i>	Provides for the investigation, allocation, control, protection, management and administration of water resources in the NT. The Act prohibits waste to come in contact with water or water to be polluted unless under authorisation.
<i>Weeds Management Act 2013</i>	Aims to prevent the spread of weeds throughout the NT, ensuring the management of weeds is an integral component of land management. It is designed to ensure there is community consultation in the creation of weed management plans and that the community takes responsibility in implementing weed management plans.
International Agreements	
<p><i>Migratory species:</i></p> <ul style="list-style-type: none"> • <i>Japan-Australia Migratory Bird Agreement</i> • <i>China-Australia Migratory Bird Agreement</i> • <i>Republic of Korea-Australia Migratory Bird Agreement</i> • <i>Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)</i> 	Australia is party to a number of international agreements to protect and conserve migratory species and their habitat. Migratory species listed on the annexes to these Agreements are placed on the migratory species list under the EPBC Act.
<i>Ramsar Convention on Wetlands</i>	<p>The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain.</p> <p>Ramsar wetlands within Australia are listed as a Matter of Environmental Significance and protected under the EPBC Act.</p>

Additional information on relevant legislation and legal obligations is provided in the Santos EHS Legal Obligations Directory, which is accessible on the Santos intranet *The Well*.

2.2 Relevant Agreements and Operating Consents

Table 2-1 lists agreements and operating consents of the geophysical operations including a summary of the key items.

Table 2-1: Agreements and Operating Consents Overview

Document	Summary
Indigenous Land Use Agreement EP No.s 82, 112, 118 and 125	Signed on 18 July 2007, this agreement between Central Land Council, Central Petroleum Ltd, Helium Australia Pty Ltd, Frontier Oil and Gas Pty Ltd, Ordiv Petroleum Pty Ltd refers to obligations under the Native Title (Cth) Act 1993. Details of this agreement are confidential and have been redacted.
Exploration Agreement EP 105, 106 and 107	Dated 14 October 2013, this agreement is between Central Land Council, Merlin Energy Pty Ltd and Santos QNT Pty Ltd. Details of this agreement are confidential and have been redacted.

The terms of this agreement are confidential and have been redacted.

Santos will ensure that prior to commencement of the Program, necessary consents and approvals will have been identified, obtained and be in place and the work will be undertaken in accordance with the terms and conditions as detailed in the CLC Agreement and the Sacred Site Clearance Certificate.

Landholder Access and Compensation Agreements are currently being negotiated with the affected pastoral leaseholders. These agreements set out arrangements for compensation payable to landholders under the *Petroleum Act 2011* and agreement on how Santos will conduct activities while on each property. All landholder consultation and negotiation will be carried out in accordance with in accordance with the *DME Petroleum Exploration Two Way Communication Consultation Process and Stakeholder Engagement Guidelines Land Access*.

2.3 Codes of Practice and Relevant Guidelines

Contractors undertaking activities as part of the Program will be required to comply with the following environmental standards, guidelines and codes of practice:

- Santos Environmental Health and Safety Management System (EHSMS).
- Santos environmental hazard standards (EHS).
- Santos Health and Safety Hazard Standards (SHHS).
- Conditions of Sacred Site Clearance Certificates.
- Australian Petroleum Production and Exploration Association (APPEA) *Code of Environmental Practice* (2008).
- Petroleum Exploration Two Way Communication Consultation Process (NT Government 30/11/2005)
- Stakeholder Engagement Guidelines Land Access (NT Government).

3 PROJECT DESCRIPTION

3.1 Project Location

The Project's proposed seismic activities will be carried out over Exploration Permits 82, 105, 112, and 125 which are located east, south and south west of Alice Springs (The Project Area) (Figure 3-1). These Exploration Permits cover a combined area of approximately 48,100km² of the Amadeus Basin. The seismic survey application covers 2514 km but Santos only expect to record approximately 1,300km. The additional kilometres have been permitted to allow for flexibility of program based on results of survey on an ongoing basis.

The Exploration Permits are located on Aboriginal, Leasehold and Freehold land.

3.2 The Seismic Method

Seismic acquisition allows the explorer to 'image' below the surface and identifies areas where oil and gas may have accumulated. The seismic method uses vibrator trucks to produce sound waves, which travel into the earth and are then reflected from subsurface geological structures (refer to Figure 3-2). The returning reflections are recorded in a digital format and sent to a seismic data processing centre to produce a 'cross-section' of the layers of the earth's crust. The following sections explain the field procedures for recording seismic data.

3.2.1 Planning

Once the exploration team of an exploration company have proposed a seismic program, the seismic program is plotted onto detailed topographic and/or satellite images (as shown in Figure 3-1).

There are two basic types of seismic survey:

- A 2D survey records data along a single line of traverse, giving a cross-sectional 'picture' of the subsurface. 2D seismic lines are normally 10km to 50km long, or longer for regional exploration surveys and spaced 500m to 5000m apart; and
- A 3D survey records data over a 'grid' of lines simultaneously, giving a three dimensional view of the subsurface, beneath an area generally covering 15km² to 1500km².

The proposed work programme and this EP covers only 2D seismic survey activities.

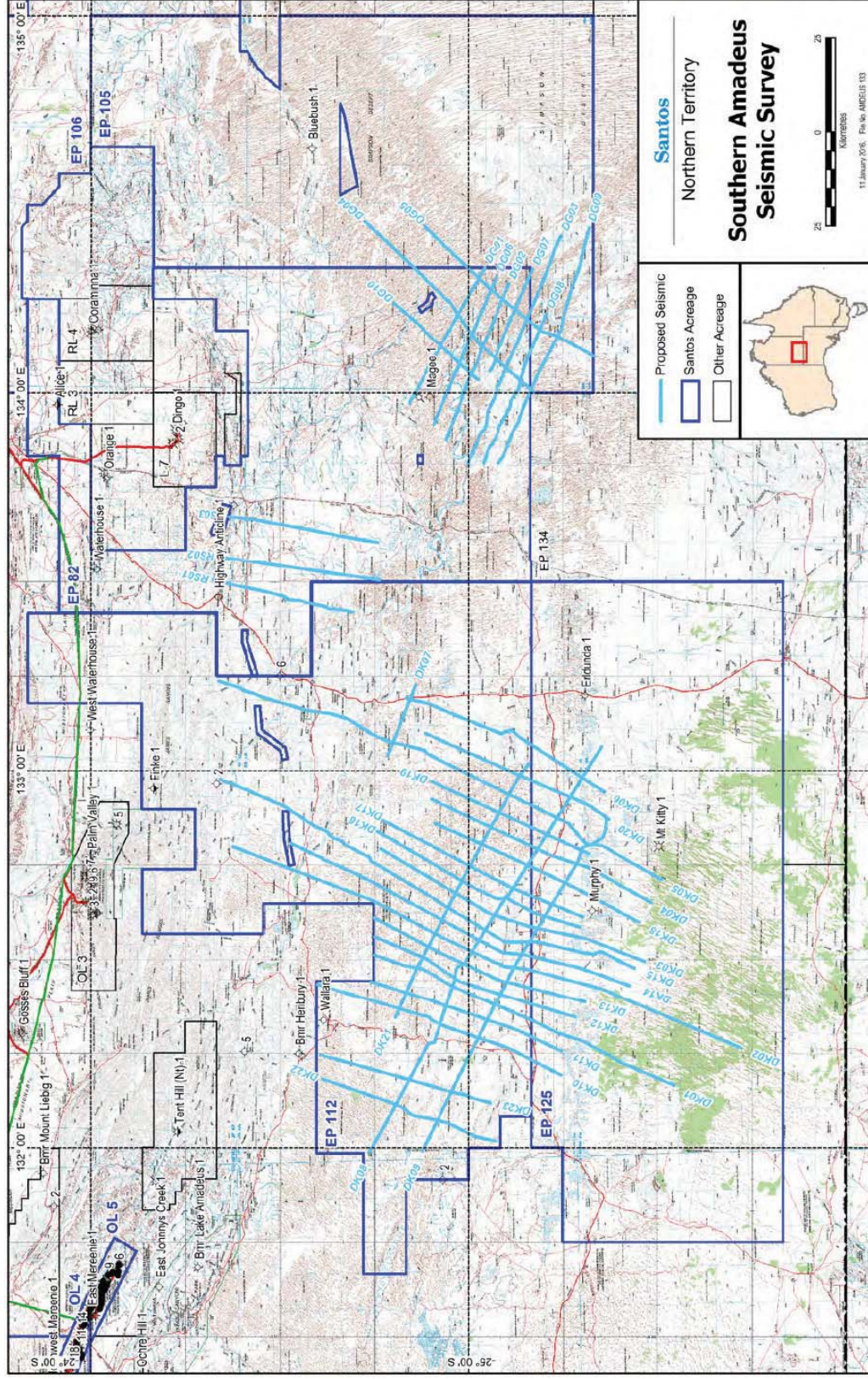


Figure 3-1: 2016 Southern Amadeus Seismic Survey

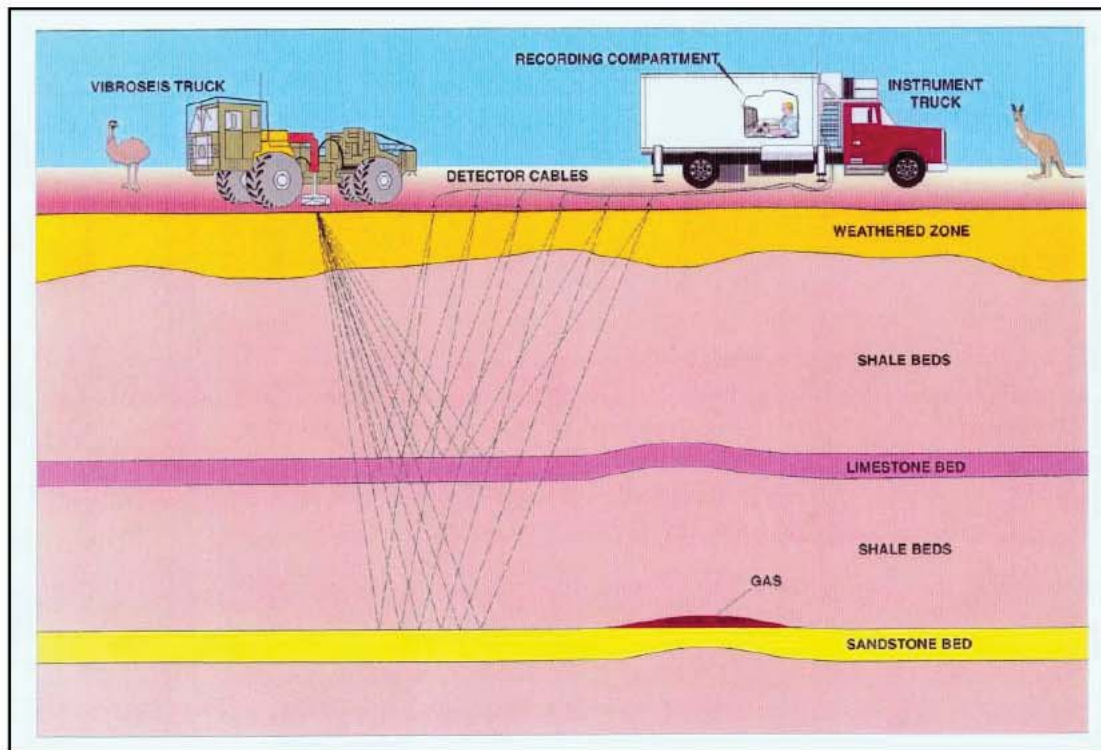


Figure 3-2: The principle of the seismic method

Seismic lines potentially impact a width of 4 to 5m. The seismic lines are laid out so as to avoid sensitive environmental sites, significant habitat, as well as cultural features such as buildings, dams, water wells and known Aboriginal heritage sites. Figure 3-3 shows line preparation with weaving and minimal cutting.

The key aspect of field acquisition is to get equipment (usually vehicular based) and personnel along the planned seismic lines and acquire sufficient data so as to adequately 'image' the subsurface. The safety of field personnel is a key consideration of any field seismic operation. This involves compromise between what is logistically, environmentally and economically possible.



Figure 3-3: Line preparation showing weaving and minimal cutting

3.2.2 Sacred Site Protection Procedures

As part of the seismic survey planning process, Santos has submitted an application for a Sacred Site Clearance Certificate (SSCC) to the Central Land Council (CLC). The application detailed the proposed project works activities including the project scope, definitive locations, proposed access routes, transportation and campsite locations.

The CLC has assessed the application and issued Santos with a CLC SSCC detailing Subject Land, Exclusion Zones, Restricted Work Areas and all conditions. The Santos Cultural Heritage team will implement all details of the SSCC, including providing a Cultural Heritage / Sacred Site assessment to Project Managers, issuing compliance actions to Project Managers, updating GIS with details of Sacred Sites, including conditions and will deliver Cultural Heritage and Sacred Site inductions to relevant personnel.

Santos will also incorporate the details of the archaeological and sacred sites provided by the Northern Territory Heritage Council and the Aboriginal Areas Protection Authority to the Cultural Heritage Assessment for the Southern Amadeus Seismic Program.

3.3 Line and Access track preparation

Line preparation will commence and be managed in line with the details of the SSCC and Cultural Heritage / Sacred Site assessment. This team operates from a small central campsite independent of the main camp (See Section 3.3.3). This camp site will most likely be moved weekly. The camp, on average, accommodates 13 personnel. The camp units are trailer mounted for ease of mobility. Campsites are set up, where possible, on sites previously used, or in areas naturally devoid of vegetation and always adjacent to any existing tracks to minimise impact on the terrain between the camp and tracks.

The line preparation crew usually operate simultaneously on different lines, characteristically using two D6 or equivalent bulldozers. Daily production of prepared line is approximately 30km (i.e. 15km per dozer) though this varies with terrain. The dozers will simply 'walk' with the blade up in easily traversable terrain, with the marks of the tracks being sufficient for the surveyors and recording crew to follow. The line position, plus tolerances for weaving the line around vegetation etc are pre-

programmed into GPS units housed in the dozers. These GPS units are kinematic dual frequency units that allow the dozer operators to get real time position fixes. These are plotted on a pilot display that also indicates the weaving tolerances for the dozer operators. The dozers weave around vegetation stands and on open ground the machines weave every 75-100m to reduce visual impact.

Blade work is kept to a minimum and generally restricted to sand dunes and flood plain crabhole country. Grader work is likewise kept to a minimum – graders are mainly used in flood plain crabhole country to smooth the tracks and knock down windrows in sand country.

All line preparation personnel are given environmental and cultural heritage inductions prior to commencing work. All machinery operators are required to observe for cultural heritage. Any sites discovered, must be avoided and reported to the Santos Representative onsite who will notify the Santos Cultural Heritage Team.

Access routes may be required in areas where there are no existing roads or petroleum activity has not been previously undertaken, but these will not require the same degree of preparation as for drilling or production operations.

The type and severity of potential impacts resulting from the preparation of access tracks and seismic lines is dependent to a certain extent on the land system in which the activities are being carried out. Disturbance to soils in some land systems, can lead to substantial erosion by water (Fatchen and Woodburn 2000) while other systems are generally more resilient and less likely to suffer any long-term impacts from soil disturbance. Due to the instability and erosion potential when disturbed, the steeper slopes and escarpments of tableland land systems are avoided.

The clearance of vegetation during access track preparation cannot be entirely avoided. During the preparation of seismic survey lines and access tracks, particular care is taken to ensure that minimal vegetation is cleared in heavily wooded areas as vegetation is likely to need active assistance to recolonise. Campsites are generally located at the nearest available naturally clear area or previously disturbed areas.

Current survey line and access track preparation techniques have been shown by a number of studies to have an insignificant impact on wildlife habitat and minimal impact on vegetation. This is due to the small and confined area of impact of survey lines and the rate of recovery of most vegetation types and surface morphology.

3.3.1 Line Surveying

Surveying commences shortly after line preparation. The field surveyors use real time kinematic GPS receivers to position receiver points for 2D surveys. Surveyors insert metal pins with numbered plastic tags to indicate the points. Selected points are marked by a wooden stake. Markers protrude about 30cm above ground level. All of these markers are removed on completion of the recording phase. Line detours are often marked with biodegradable flagging that is also removed. Each survey team (one surveyor in a light 4WD vehicle) generally makes only one pass over any given section of line. Back tracking may occur in areas where vehicle access routes have deviated from the true line position and markers have to be inserted by personnel on foot.

3.3.2 Recording

Recording normally commences two to three weeks after the start of line preparation. This operation is the largest part of the seismic operation in terms of personnel and vehicles. A recording crew would normally consist of up to 34 personnel and 16 vehicles. The size of the crew will vary depending on the recording technique used, terrain and season.

2D Seismic Operations

Work commences with the laying of cable and deployment of geophone bundles from light 4WD vehicles. Geophone strings normally consist of 12 interconnected geophones and are dropped off at each receiver station. These strings are looped onto metal hangers for ease of handling. The geophones are then pulled off the hanger and planted in the ground by personnel on foot. Once planted, the string (typically 20m or 25m in length to match the distance between receiver points) is connected to a “take out” on the recording cable.

The recording cable is spooled out from the side of the vehicle and offset to one side of the line to prevent damage from following vehicles.

Recording in 2D mode would normally commence when approximately 8km of cable and geophones have been laid. This layout is termed “the spread” and a preselected “live” section of it picks up the acoustic energy reflected from subsurface layers, converts it to electrical energy and transmits it to the instrument recording truck.

The instrument recording truck that collects, decodes and amplifies these signals, sets up at a suitable location approximately 100m from the spread and connects to it. Once the instruments and spread have been satisfactorily tested, recording is ready to commence.

The acoustic energy source is normally an array of three or four truck mounted vibrator units, electronically synchronised to vibrate in phase with each other. They line up along the seismic line, a few metres apart, centred on midway between two receiver points. Simultaneously each unit, on command from the instrument truck, inputs one or more frequency sweeps into the ground at each source point. Each sweep lasts for only a few seconds. Generally four seconds of reflected data is recorded. The source points are typically 20m or 25m apart. On completion of one source point the set of vibrators are moved to the next source point.